Diagnostic utility and safety of transjugular kidney biopsy in the obese patient

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Abstract

Background. The obese patient may be potentially at high risk for traditional percutaneous ultrasound-guided biopsy. The utility of transjugular kidney biopsy (TJKB) in this group of patients has not been established.

Methods. We conducted a retrospective analysis of 37 obese patients who underwent TJKB at our centre. The kidney was approached via the right renal vein in 31 patients. Under fluoroscopy, core biopsies were obtained from the lower pole with a 19G biopsy needle. Post-procedure venogram was performed to assess for contrast extravasation indicating capsule perforation or communication with the collecting system. Patients were followed for procedure-related complications. Mean weight was 128 kg (range: 77–187 kg) and body mass index was 44 kg/m² (range: 34–64 kg/m²). Mean creatinine was 2.2 mg/dl (range: 0.5–6.5 mg/dl). Fifteen patients had diabetes, five of whom were nephrotic; 10 other patients had nephrotic range proteinuria.

Results. Of the 37 patients, six were hospitalized at the time of biopsy and three were admitted for observation. All patients returned to baseline activity the day following procedure. Histopathological diagnosis was made in 33 cases (89.2%) with a mean of 19.2 glomeruli (range: 0–62 glomeruli) per patient. There was one major complication: a delayed retroperitoneal bleed requiring multiple transfusions. Contrast extravasation outside the capsule occurred in five patients and extravasation into the collecting system occurred in three. Body mass index was not associated with number of glomeruli obtained or complication rate.

Conclusions. TJKB in obese patients is a relatively safe, reliable and minimally invasive procedure with an excellent diagnostic yield.

Keywords: body mass index; complications; diagnosis; obesity; transjugular kidney biopsy

Introduction

Renal biopsy continues to play an essential role in the clinical assessment of haematuria, proteinuria and kidney failure [1–3]. The diagnostic and prognostic information it provides is critical in directing the management in patients with kidney disease. Traditional techniques, including ultrasound or the computerized tomography (CT)-guided percutaneous approach, have proven safe when performed in low-risk patients by experienced operators [4,5]. Despite technical advances in radiographic imaging and tissue-sampling biopsy equipment, high-risk patients frequently do not undergo biopsy or are subjected to invasive open or laparoscopic surgery. This group of patients includes those with bleeding risk due to coagulopathy or platelet dysfunction, solitary kidney [6] and those in whom there is poor visualization of the kidney due to body habitus or abnormal kidney location.

The obese patient is considered to be at potential high-risk for the ultrasound-guided percutaneous approach, due to poor kidney visualization by this technique. Poor visualization can potentially result in both technical failure and bleeding complications. These patients do not have an intrinsic bleeding risk associated with their obesity. The same patients may be difficult to biopsy by CT guidance, being too heavy or too large for the scanner. To our knowledge, there is no published study that has assessed complications of percutaneous biopsy specifically in the obese patient.
In the obese patient population, laparoscopic biopsy has been utilized successfully when the percutaneous approach is not possible. Though relatively safe and having a very high diagnostic yield, this procedure requires general anaesthesia and lengthy recovery times [7,8].

Transjugular kidney biopsy (TJKB) has been used in high-risk patients in several series [9–13]. Most of these patients underwent biopsy via this approach due to risk of bleeding, though morbid obesity was described as an indication in some patients. High diagnostic yield and low complication rates have been described in those studies.

The theoretical advantage of the transjugular approach is a lower likelihood of capsular perforation with the inside-out approach in comparison to the 100% capsular perforation rate with percutaneous biopsy. In addition, there is less chance of large vessel perforation, since the biopsy needle is directed away from larger vessels and is advanced as distally as possible into the medullary interlobar veins and, moreover, when bleeding does occur, it will do so back into the venous system [6]. The disadvantage compared with ultrasound-guided biopsies is the potentially low diagnostic yield due to the need to traverse the medulla first in order to reach the more distal cortex, which is approached cautiously due to its proximity to the capsule.

The purpose of the present study was to evaluate the safety, feasibility, diagnostic yield and potential complications of the transjugular approach in obese patients.

Subjects and methods

This is retrospective analysis of the data on 37 consecutive obese patients, who underwent TJKB between April 2001 and December 2002 at Johns Hopkins Hospital. The University Institutional Review Board approved the study. All patients were considered unsuitable candidates for conventional approach due to their body habitus. This was based on clinical examination by the attending nephrologist. Indications for biopsy included unexplained proteinuria, haematuria or acute renal failure in the context of various underlying disorders.

Demographic, clinical and relevant laboratory data were abstracted from the patient hospital records and entered into a dedicated database. The number of glomeruli seen by light microscopy, immunofluorescence and electron microscopy was recorded from pathology reports, as was the diagnosis. Regression analysis was used to determine the association of body mass index (BMI) with other factors. All analyses were two-sided and used a type I error rate of 0.05. All analyses were performed using the Stata 6.0 statistical package (Stata Corporation, College Station, TX, USA).

Procedural technique

Biopsies were performed by six interventional radiologists with standard fluoroscopic equipment. All biopsies were performed with the Liver Access and Biopsy Set (Cook, Indianapolis, IN, USA), which comprised of (i) a 7F, 50.5 cm transjugular sheath with a 14G inner stiffening cannula; (ii) a 5F, 80 cm multipurpose catheter; and (iii) a 19G, 60 cm biopsy needle with a 2 cm throw length. The procedure began with the insertion of a 9F vascular sheath (Cordis, Miami, FL, USA) into the right internal jugular vein under direct sonographic guidance. This was followed by insertion of a standard Bentson wire (Cook, Bloomington, IN, USA) into the inferior vena cava. Selective catheterization of the renal vein was achieved with the multipurpose catheter. The right renal vein was used unless there was technical difficulty, in which case the left vein was cannulated. After the catheter was manipulated into the posterior lower pole branch of the renal vein, the Bentson wire was exchanged for a 145 cm Amplatz Super Stiff Wire (Boston Scientific Corp., Watertown, MA, USA). Subsequently, the 7F transjugular sheath with the metal inner cannula was advanced into the selected lower renal vein. Injection of either iodinated contrast (Omnipaque 300®; Amersham, Princeton, NJ, USA) or gadopentetate dimeglumine (Magnevist®; Berlex Laboratories, Wayne, NJ, USA) into the sheath was performed to confirm position in the renal vein. The operating radiologist determined which contrast agent would be used, based on baseline renal function. Gadolinium was used for patients with serum creatinine >2.0 mg/dl. Kidney biopsies were performed by advancing the 19G, 60 cm biopsy needle gently through the metal cannula as distally as possible into a medullary interlobar vein of the lower pole of the kidney. An average of 5.5 passes was made during each kidney biopsy session. Renal venogram was performed at the end of procedure to evaluate for extracapsular penetration or communication with the urinary collecting system. When significant extravasation was noted, follow-up injection was repeated after 5 min to determine if any additional treatment, such as embolization of the bleeding vessel, would be necessary. Outpatients were observed for 6 h in the recovery area with vital signs every 15 min prior to discharge. Tissue samples were processed in a standard manner for evaluation by light microscopy, immunofluorescence and electron microscopy. Specimens obtained were examined by one of two pathologists.

Results

Demographics and patients characteristics

A total of 37 obese patients were biopsied. The left kidney was biopsied in six patients. Population characteristics are shown in Table 1. Twenty-eight patients (78%) were discharged from the recovery area and three patients were admitted. One was admitted for a large amount of contrast extravasation on initial assessment; another also had extravasation noted in the context of temporary cessation of anticoagulation. The third patient had severe hypertension following the procedure (systolic pressure >200 mmHg). All were discharged the following day with stable vital signs and haematocrit. Six patients were inpatients at the time of biopsy.

Diagnostic yield of TJKB

The average number of glomeruli per sample was 19.2 (SD: 12.9; range: 0–62 glomeruli). Eighty-one per cent
of samples had greater than 10 glomeruli processed. BMI was not correlated with the number of glomeruli obtained \((P = 0.1)\). Definitive diagnosis was possible in 33 of 37 patients (89%). Two patients had medullary samples obtained with no glomeruli. Both refused repeat biopsy. Two other patients did not have sufficient tissue for definitive diagnosis. Both had lupus nephritis and the four glomeruli available for study in each case were not sufficient to rule out proliferative lesions. The available tissue was only sufficient for presumptive diagnoses of World Health Organization classes II and V lupus nephritis. Neither patient was rebiopsied and both responded to therapy targeted at the aforementioned lesions. There were three other patients with fewer than 10 glomeruli obtained; however, in all these cases, there was sufficient tissue for definitive diagnosis.

Table 2 summarizes diagnoses by underlying conditions. Nine of 15 diabetic patients had diabetic nephropathy as a primary diagnosis. Four of these patients had superimposed pathology requiring separate intervention. It is notable that five diabetic patients had other non-diabetic glomerular pathology. Lupus patients had the full range of lupus-related histopathology, as shown in the table.

### Complications of TJKB

Complications seen in the population are summarized in Table 3. All 12 minor complications were self-limited. A total of eight patients had temporary extravasation of contrast on post-biopsy venogram. Five had extravasation of contrast outside the capsule. Three others had temporary extravasation into the collecting system with associated haematuria. On follow-up contrast injection, none had ongoing extravasation. Four other patients had haematuria without noted extravasation. Haematuria had resolved in all but one patient by the time of discharge from the recovery area. The final patient needed a urinary catheter temporarily in the recovery area, due to bladder outlet obstruction from a blood clot. The haematuria in this case resolved within 24 h of discharge. BMI did not predict development of any of the complications in this group of patients \((P = 0.7)\).

Only nine of the 37 patients had their pre- and post-haematocrits drawn within 48 h of each other. The mean decrease in haematocrit in this group of patients was 1.4% (range: decrease 3% to increase 1.3%). Twenty patients had follow-up haematocrits within 2 weeks of the procedure. The mean decrease in haematocrit for these patients was 1.1% (range: decrease 4.9% to increase 3.6%). BMI was not associated with changes in haematocrit.

Only one patient had a serious complication. This patient was an inpatient at the time of biopsy. Approximately 7 days after the biopsy, he was noted to drop his haematocrit by 12% (from 41.3% to
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Discussion

This study comprises the largest series to date of obese patients undergoing TJKB. The procedure appears to be a well-tolerated, effective and relatively safe alternative in this group of patients at potential high-risk for percutaneous kidney biopsy. It, therefore, adds to the techniques already available to biopsy these patients who otherwise may have to forego a highly clinically useful procedure.

The first large series of patients undergoing kidney biopsy via the transjugular approach was described in 1990 by Mal et al. [11] in 50 patients with contraindications to percutaneous approach. In their report on 200 consecutive cases, Mal et al. [12] demonstrated a high diagnostic yield of 83% and a relatively safe procedure. Despite the high-risk nature of this population, only four (2%) patients required blood transfusion, three of whom had large perirenal haematomas and one excessive haematuria. Cluzel et al. [9], in the largest study to date of 400 consecutive patients, described excellent diagnostic yield (94%) and safety, with major complications in only 1% (rates comparable to a control group undergoing percutaneous approach). The number of obese patients biopsied in both studies was only 17 and five subjects, respectively. Despite the success with this procedure, its use has remained somewhat limited, particularly in the United States.

Of the 32 patients studied in the first large series of patients undergoing laparoscopic biopsy [7], 14 were obese. All cases had sufficient tissue for histopathological diagnosis. Half of the patients were discharged on the day of the procedure. Two major complications occurred, with one patient developing a perinephric 300 cc bleed, while the other died from apparent unrelated gastrointestinal bleeding. Though this procedure was considered by the authors to be safe, reliable and minimally invasive, all surgeries required general anaesthesia and mean time to recovery to normal physical activity was 1.7 weeks. In an update of this study by the same group, 30 of 74 had the procedure due to obesity; the results reported were less detailed, but not significantly different from the earlier series [8].

Sam et al. [13] in their recent series of 29 patients with liver disease undergoing transjugular renal biopsy felt that three criteria needed to be met in order for this procedure to be more widely accepted. First, an adequate sample needs to be obtained to allow accurate diagnosis and, second, the procedure needs to be sufficiently safe for high-risk patients. Finally, it needs to be documented that the information obtained is helpful in the clinical decision-making process and, hence, will influence the quality of care delivered. In the obese population in whom this procedure was performed at our institution, we feel that we have been able to meet those three criteria.

The tissue samples obtained in this study were sufficient in 33 of the 37 patients and helpful in establishing specific diagnoses in another two patients. In addition, 30 patients (81%) had more than 10 glomeruli for analysis and the average number of glomeruli (19.2) processed is comparable to the number obtained (19.4) by Sam et al. [13]. Although the diagnostic success rate in this study of 89% is slightly less than that reported by Sam et al. (97%) [13], who had an on-site pathologist review specimens, it is comparable to the 78.6% [12] and 94% [9] diagnostic rate reported in larger series. Though performed in a different population, the yield of percutaneous biopsy generally ranges from 95.5% to 98.8% [4,9,14].

The procedure was relatively safely performed in this cohort. There was one major complication in this study: a retroperitoneal haematoma. The patient required 9 U of red blood cells and underwent two angiograms with embolizations, though no focal contrast extravasation was ever visualized. As described previously, the bleeding was highly unusual as it occurred 7 days after the procedure. All other complications were self-limited, as described. The major complication rate was similar to that described in larger studies of transvenous biopsy [9,12]. Major complication rates from percutaneous biopsy have been described in <1% in one study [4] to
6.6% in another [5]. It should be noted that other than obesity, few of the patients in the current study had other high risks, namely bleeding diatheses or thrombocytopenia, as has been observed in other cohorts.

The procedure was well tolerated, with all patients returning to their baseline activity the day following the procedure. This is in contrast to laparoscopic biopsy patients who require significantly longer recovery times (average: 1.7 weeks) [7]. In addition, most of our patients were discharged after 6 h of observation. As there is evidence in the percutaneous biopsy literature that bleeding may not be evident in 20% of patients until after 8 h of observation [5], caution is required with decisions regarding the length of observation. Several features of the procedure might make it possible to have shorter observation periods: the lower risk of capsular perforation, the ability to detect capsular perforation in many instances by post-procedure venogram, the likelihood of a bleed occurring back into the venous system and the use of a smaller gauge (19G) biopsy needle than is employed in percutaneous biopsies. Certainly, those with unstable vital signs, ongoing haematuria, flank pain or with evidence of extravasation require more extended observation.

The clinical utility of this procedure is reflected in the varied diagnoses obtained in the diabetic and lupus populations. Though it is difficult to prove that the quality of care delivered is affected by biopsy result, one can argue, based on the diagnoses, that it may be. Several studies have shown that diabetic patients undergoing kidney biopsy frequently have non-diabetic renal disease [15–17]. Indeed, in this study, five out of 15 (33%) diabetic patients had other diagnoses and another four patients had other diagnoses superimposed upon their diabetic nephropathy. Certainly, the indications for biopsy in these patients were such that one might have expected non-diabetic renal disease.

Though this is the largest study of its kind, it is still limited by the relatively small number of patients studied. The small number does not allow accurate prediction of risk factors for complications or the assessment of the effect on the long-term outcome of the procedure. In addition to the risk of contrast exposure, venography may not necessarily show all perforations [6] and occult capsular perforations may have been missed. We do not have cost data, but expect that in many patients the ability to have this procedure done as an outpatient might balance the cost of an overnight stay recommended by many nephrologists performing a percutaneous approach. In addition, it is likely that this approach is less expensive than the laparoscopic approach. Furthermore, since this approach is only recommended in those patients in whom the percutaneous approach is not possible, cost comparisons may not necessarily be applicable. This procedure does require the expertise of a skilled interventional radiologist, precluding its use in some communities.

In conclusion, based on our experience, we have demonstrated that TJKB is a feasible technique in the obese population. The high diagnostic yield allows for appropriate clinical management of patients undergoing this approach. In addition, the procedure is well tolerated, relatively safe and might prove to be the procedure of choice in this group of patients.

Conflict of interest statement. None declared.

References

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